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Lithium insertion into titanium dioxide (anatase) electrodes: Microstructure and electrolyte effects

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Abstract

Insertion characteristics of anatase electrodes were studied on single-crystal and polycrystalline electrodes of different microstructures. The lithium incorporation from propylene carbonate solution containing LiClO4 and Li(CF3SO2)2N was studied by means of cyclic voltammetry (CV), the quartz crystal microbalance (QCM) and the galvanostatic intermittent titration technique (GITT). The electrode microstructure affects both the accessible coefficient x and the reversibility of the process. The highest insertion activity was observed for electrodes composed of crystals with characteristic dimensions of ~10-8 m. The insertion properties deteriorate for higher as well as for smaller crystal sizes. Enhanced insertion was observed in Li(CF3SO2)2N-containing solutions. Lithium insertion is satisfactorily reversible for mesoscopic electrodes; the reversibility in the case of compact polycrystalline and single-crystal electrodes is poor. The reversibility of the insertion improves with increasing electrolyte concentration. The lithium diffusion coefficient decreases with increasing x and ranges between 10-15 and 10-18 cm2 s-1.

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Keywords

Anatase, Galvanostatic intermittent titration technique, Lithium insertion, Quartz crystal microbalance, Titanium dioxide